REMARKS

The Examiner has rejected claims 1, 2, 4-7, 8-12, 14-17, 19 and 21-23 under 35 U.S.C. 103(a) for being unpatentable over Carl et al. (U.S. Patent No. 5,468,687) in view of Slomowitz (U.S. Patent No. 4,888,088) as previously applied. The Examiner as rejected claims 3, 13, 18 and 20 under 35 U.S.C. 103(a) for being unpatentable over Carl '687 and Slomowitz '088 as applied to claims 1, 8 and 14 above, and further in view of Hasegawa (U.S. Patent No. 5,677,015) as previously applied. The Examiner has rejected claims 1-23 are rejected under 35 U.S.C. 103(a) for being unpatentable over Hasegawa '015 in view of Slomowitz '088 as previously applied. The Examiner has rejected claims 24-31 under 35 U.S.C. 103(a) for being unpatentable over Hasegawa (5,677,015) in view of Slomowitz '088 as previously applied. The Examiner has rejected claim 32 under 35 U.S.C. 103(a) for being unpatentable over Hasegawa, in view of Slomowitz, as applied to claim 24 above, and further in view of Nishiki et al. (U.S. Patent No. 5,989,782) as previously applied.

It is Applicants understanding that the cited references fail to teach or render obvious Applicant's invention as claimed in claims 1-32. Applicant teaches and claims a method of annealing a dielectric film. According to Applicant's claimed method, a dielectric layer is formed on a substrate. A plasma comprising ionized atoms is then generated in a first chamber. The ionized atoms are then fed through a conduit coupling the first chamber to a second chamber where the substrate having the dielectric film to be annealed is located. While the ionized atoms travel through the conduit to the second chamber the ionized atoms become a electrically neutral. The dielectric layer is then exposed to the electrically neutral active atomic species in the second chamber. By flowing the plasma mixture through a conduit for sufficient period

of time to insure that all of the ionized atoms become electrically neutral, the substrate is only exposed to an electrically neutral high reactive atoms and not to ionized atoms. Ionized atoms can be electrically damaging to the substrate and electrical devices formed thereon. Applicant has amended claims 1-32 to more particularly point out and distinctly claim this aspect of the invention.

It is Applicant's understanding that neither Slomowitz, Carl or Hasegawa teach flowing a plasma comprising ionized atoms through a conduit coupling a first chamber and second chamber wherein the ionized atoms become electrically neutral prior to entering the second chamber as claimed by Applicant.

As such, the cited references fail to teach or render obvious Applicants invention as claimed in claims 1-32. Applicant therefore respectfully the removal of the 35 U.S.C. 103 rejections of claims 1-32 and seeks an early allowance of these claims.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

1. (Amended) A method of annealing a dielectric layer, said method comprising the steps of:

forming a dielectric layer on a substrate;

generating [an active atomic species in] ionized atoms in a first chamber; [and]

flowing said ionized atoms through a conduit coupling said first chamber to a second chamber, wherein said ionized atoms become electrically neutral active atomic species before reaching said second chamber; and

exposing said dielectric layer to said active atomic species [wherein said substrate is located in a] in said second chamber [separate from said first chamber while exposing said dielectric layer to said active atomic species].

2. The method of claim 1 wherein said active atomic species comprises reactive oxygen atoms.

3. The method of claim 1 wherein said active atomic species comprises reactive nitrogen atoms.

4. The method of claim 1 wherein said dielectric layer comprises a metal-oxide.

5. The method of claim 1 wherein said dielectric layer comprises a transition metal dielectric.

6. The method of claim 5 wherein said dielectric layer comprises tantalum pentaoxide (Ta_2O_5).

7. The method of claim 1 wherein said dielectric layer is exposed to said active atomic species while being heated to a temperature of less than 400°C.

8. (Amended) A method of forming a dielectric layer comprising:

generating [an active atomic species] a plasma comprising ionized atoms in a first chamber; [and]

flowing said ionized atoms through a conduit coupling said first chamber to a second chamber, wherein said ionized atoms become electrically neutral active atomic species before reaching said second chamber; and

depositing a dielectric layer onto a substrate by chemical vapor deposition in [a] said second chamber and while depositing said dielectric layer, providing said active atomic species into said second chamber.

9. (Amended) The method of claim 8 wherein said active atomic species comprises reactive oxygen atoms [radicals].

10. The method of claim 8 wherein said dielectric layer a metal oxide dielectric.

11. The method of claim 8 wherein said dielectric layer comprises a transition metal dielectric.

12. The method of claim 11 wherein said dielectric layer comprises tantalum pentaoxide (Ta_2O_5).

13. The method of claim 8 wherein said dielectric layer comprises a silicon-oxide.

14. (Amended) A method of annealing a deposited oxide, said method comprising the steps of:

locating a substrate in a first chamber, said substrate having a deposited oxide formed thereon;

generating a plasma comprising [reactive] ionized oxygen atoms in a second chamber; [and]

flowing [transporting] said [reactive] ionized oxygen atoms from said second chamber into said first chamber through a conduit wherein said ionized oxygen atoms become electrically neutral reactive oxygen atoms while flowing from said second chamber to said first chamber; and

exposing said deposited oxide to said reactive oxygen atoms.

15. The method of claim 14 wherein said deposited oxide is exposed to said reactive oxygen atoms while heating said substrate to at a temperature of less than 400°C.

16. The method of claim 14 wherein said second chamber is a microwave applicator cavity of a remote plasma generator.

17. The method of claim 14 wherein said reactive oxygen atoms are formed by generating a plasma from O_2 molecules.

18. The method of claim 14 wherein said reactive oxygen atoms are formed by generating a plasma from N_2O molecules.

19. The method of claim 14 wherein said reactive oxygen atoms are formed by generating a plasma from O_2 molecules utilizing microwaves.

20. The method of claim 14 wherein said deposited oxide is a silicon-oxide.

21. The method of claim 14 wherein said deposited oxide is a metal-oxide.

22. The method of claim 21 wherein said deposited metal oxide is a transition metal oxide.

23. The method of claim 22 wherein said transition metal-oxide is tantalum pentaoxide (Ta_2O_5).

24. (Amended) A method of forming a capacitor, said method comprising the
steps of:

forming a bottom electrode;

depositing a transition metal dielectric on said bottom electrode in a deposition chamber;

generating [reactive] a plasma comprising ionized oxygen atoms by forming [a] said plasma from an oxygen containing gas in a microwave applicator cavity in a remote plasma generation chamber;

flowing said ionized oxygen atoms through a conduit coupling said first chamber to a second chamber, wherein said ionized oxygen atoms become electrically neutral reactive oxygen atoms before reaching said second chamber; and

annealing said transition metal dielectric in said second chamber by exposing said transition metal dielectric to said reactive oxygen atoms[, wherein said annealing step occurs in a chamber separate from said microwave applicator cavity]; and

forming a top electrode [on] above said reactive oxygen atom exposed transition metal dielectric.

25. The method of claim 24 wherein said transition metal dielectric is tantalum pentaoxide (Ta_2O_5) deposited by chemical vapor deposition utilizing a source gas comprising TAETO.

26. The method of claim 24 wherein said transition metal dielectric is tantalum pentaoxide (Ta_2O_5) formed by chemical vapor deposition utilizing a source gas comprising TAT-DMAE.

27. The method of claim 25 wherein said tantalum pentaoxide dielectric layer is formed utilizing a source gas comprising O_2.

28. The method of claim 24 wherein said transition metal dielectric layer is deposited at a temperature between 300-500°C.

29. The method of claim 24 wherein said transition metal dielectric is formed with a source gas comprising N_2O.

30. The method of claim 24 wherein said transition metal dielectric is annealed in the deposition chamber.

31. The method of claim 24 wherein said transition metal dielectric film is annealed at a temperature less than 400°C.

32. The method of claim 24 wherein said transition metal dielectric is annealed in a chamber different than the deposition chamber in which said transition metal dielectric was deposited